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September 14, 2006

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Subject: **REPORT ON VOIP AT THE LAC/USC REPLACEMENT FACILITY**

In accordance with the Board instruction on August 22, 2006, attached is our report on the use of Voice over Internet Protocol (VoIP) telephony services for the LAC/USC Replacement Facility. After reviewing the benefits, risks, reliability, and costs of alternatives, the report recommends the implementation of VoIP technology at this facility.

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Attachment

c: Board IT Deputies
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"To Enrich Lives Through Effective And Caring Service"

VoIP at the LAC/USC Replacement Facility

On August 22, 2006, the Board of Supervisors -

Instructed the Chief Information Officer, in collaboration with the Chief Administrative Officer and the Directors of Health Services, Public Works, and Internal Services, to provide within three weeks a thorough analysis of the risks, benefits, reliability, security and costs (including operational costs) of installing VoIP at the LAC/USC Replacement Facility versus other options available in telephone technology today. Questions addressed should include, but not be limited to the following:

- *Was an analysis of telephone options for the Replacement facility (including risks, benefits, and costs) conducted prior to the decision to implement VoIP? If so, what were the results?*

- *What are the implementation, maintenance, and ongoing costs of providing VoIP at the Replacement Facility?*

- *What are the back-up systems for telephone and data should Internet access fail?*

- *Does VoIP require special staffing and training? Is that technical skill available in the County? If not, who will provide this technical support and at what cost?*

- *What other major hospitals use VoIP? Do these hospitals use VoIP as their primary telephone system? What type of backup systems do these hospitals offer?*

The attached report (Attachment A) provides a detailed response to the Board's questions and provides additional background information on how the County's VoIP strategy was developed to ensure a measured and responsible role out of this new telephone service.

The LAC/USC Medical Center is scheduled to open in November 2007. To effect an operational status, there is a requirement for approximately 8,500 telephone lines to be implemented in the Replacement Facility. At issue is whether or not the facility should be built with a traditional telephone infrastructure and functionality or be designed to use VoIP technology/services? The following is a summary response to the questions asked:

Was an analysis of telephone options for the Replacement facility (including risks, benefits, and costs) conducted prior to the decision to implement VoIP? If so, what were the results?

There was no analysis of telephone system alternatives specifically for the LAC/USC Replacement Facility because:

- The telephone industry, equipment manufacturers and market had already determined that IP telephony technology would be the preferred technology for telephone systems now and for the future.

- County staff had already installed numerous (Board approved) IP telephone systems in concert with the June 2004 letter to the Board articulating the new direction for implementing telephony solutions in new facilities and as a replacement solution for old/expired PBX technology.

- Implementing a VoIP telephony solution in a new facility where technology will play a critical role in enabling the delivery of patient services was thought to be essential. Implementing a traditional solution would limit the opportunity to take advantage of new communication solutions and resultant application services that could lead to improved staff productivity and patient care.

- IP telephony for the LAC/USC Replacement Facility was part of the Department of Health Services "Enterprise Strategy for Voice Communications" dated November 2004. This document identified VoIP as the preferred solution for the new facilities - which was in-line with the direction adopted for VoIP technology in June 2004.

Benefits

VOIP offers many benefits which are further detailed in the attached report. However, at a summary level they include:

- There are no costs associated with telephone instrument relocations (adds, moves and changes). During emergencies new work locations can be set up instantly using the same telephone numbers.

- Telephone Companies are moving away from traditional solutions and are focusing their resources in support of VoIP services. The County's adoption of VoIP represents the reality of the change and puts in place a planned and measured approach for ensuring the County continues to have a viable and cost effective voice communication solution.

- VoIP can be WIFI (wireless) enabled providing facility staff the opportunity to carry their phone with them. In a medical facility, this has tremendous

potential to improve productivity while increasing clinical staff communications.

- Phones can be instantly turned on and turned off when they are not needed by medical center staff rather than requiring coordination through a telephone provider.

- VoIP provides for unified messaging (i.e., normal voice communications, email, voicemail and text messages can be retrieved by a single device remotely or locally).

Risks

VoIP is viable and there is minimal risk associated with the technology itself. However, VoIP must operate on the Replacement Facility's data network. This is a critical element in ensuring the success of a VoIP installation. Recognizing this requirement, every effort is being directed to building a sustainable and redundant data network at the Replacement Facility. Additionally, if the option selected is to support VoIP as an on-site hosted service, DHS staff must be trained in the management of the data network and the VoIP application servers and software. While DHS and the CIO believe there are significant near- and long-term benefits to the implementation of VoIP, they are also aware of operational issues and are working with ISD and other vendors to ensure all identified critical success factors are addressed to mitigate any unnecessary risk.

In addition to the above actions to mitigate risk, ISD, CIO and DHS are also exploring other option(s) that could result in the adoption of a managed solution including the operational management of the Replacement Facility's data network. These alternatives are as follows:

- ISD is working with AT&T to host the VoIP application within the AT&T network which will include quality of service monitoring. This is an existing AT&T service option that can be ordered under the existing Carrier Services Contract. Adoption of the service option could greatly minimize the risk of any system failure for calls made outside the facility. In fact, AT&T will commit to providing the same service level agreements that they do for traditional phone service.

- DHS is assessing their current data network support capabilities (something that needs to be done regardless of whether LAC/USC is equipped with VoIP or a traditional phone service).

What are the implementation, maintenance, and ongoing costs of providing VoIP at the Replacement Facility?

The cost's of providing VoIP and other alternative telephone systems is provided on Attachment (B). The estimates are based on the original design of 6,000 business telephones, 1,000 single line telephones, 500 wireless telephones, voice mail for 6,000 users, and a back-up system of 1,000 traditional phone lines.

Cost estimates, including one-time as well as annual costs over seven years (useful life of a telephone system) have been developed for the following four scenarios:

- A traditional PBX system (total costs of $14.3 million)
- A traditional Centrex system (total costs of $24.6 million)
- A VoIP System hosted on-site at the Medical Center (total costs of $20.9 million)
- A VoIP System hosted off-site by AT&T (total costs of $19.9 million)

What are the back-up systems for telephone and data should Internet access fail?

Unlike residential VoIP services, the LAC/USC Replacement Facility IP telephone system will not use the public Internet. Instead, the County IP telephone services would reside on the County's/Medical Center's internal data network. This data network is being designed to support critical medical and business applications including IP telephony services through redundant fiber optic links, servers, network switches and power sources.

To validate the plan and ensure a highly reliable and redundant data network, an independent consultant has been engaged to validate and make recommendations on the data network design under consideration. While the IP telephone system would operate on this internal data network, should a failure occur, a back-up, traditional telephone system (i.e., PBX/Centrex) will be implemented to provide communications for critical locations (as determined by DHS) throughout the facility. It should be noted that this is a standard practice and is in place today at the Medical Center as a back-up to the AT&T provided Centrex telephony service.

Does VoIP require special staffing and training? Is that technical skill available in the County? If not, who will provide this technical support and at what cost?

Not unlike any other computer-based applications, the IP telephony system requires routine database back-up, software updates, and real-time server monitoring. These types of tasks have not been needed with traditional telephone systems and therefore IP telephony support staff at DHS will require training in the new technology and support practices.

While ISD staff has been formally trained in IP telephony system support and maintenance, and is currently maintaining several departmental VoIP systems, DHS in developing their VoIP strategy (DHS "Enterprise Strategy for Voice Communications" of November 2004) opted to install and operate their own VoIP servers at each of the hospital locations. This contrasts with the model supported by ISD where they provide centralized support services for departments implementing VoIP at the Downey data center. In addition, as indicated above, data network resources have been a concern of DHS, ISD, and the CIO since these staff resources are essential in ensuring the reliability and sustainability of a VoIP solution. Until DHS is adequately trained and ready to assume operational VoIP system support, they will pursue contracting for additional outside services that may include support and management for their data network operations..

What other major hospitals use VoIP? Do these hospitals use VoIP as their primary telephone system? What type of backup systems do these hospitals offer?

A growing number of hospitals within the United States, as well as internationally, use VoIP. CIO staff contacted six of the larger facilities to assess the size, scope and operational impact VoIP has had within their facilities. Specifically, we obtained information on the number of phones installed, was VoIP their primary telephone system and did they have a back-up system in the event of a VoIP outage. This information is provided in Attachment (C) of this report.

To ensure a high degree of due diligence, the CIO, ISD and DHS sent an evaluation team to assess the VoIP implementation and operation at the Northwestern Memorial Hospital in Chicago, IL. This is a teaching hospital with 544 primary care beds and 167 beds in the Women's Hospital. It is the largest birthing center in Illinois, a Level 1 Trauma Center and treated over 70,000 patients last year. After an extensive review with Northwestern management, technical support staff and clinicians, DHS representatives were pleased with the operational integrity demonstrated by the VoIP solution implemented and excited at the potential of the technology to improve the management and coordination of clinical staff in the delivery of patient services. At the end of the day, DHS staff saw value and were reassured regarding the viability of implementing VoIP technology at the LAC/USC Replacement Facility. The highlights of that review are reflected in Attachment D and are summarized as follows:

- Northwestern has a total of 8,000 phones. They have installed 4,000 IP phones to date and are continuing their conversion of 100 phones per week away from Centrex service to IP telephony.

- Northwestern reported that the new VoIP system is very reliable. They contrasted this with the fact that they were handling approximately 300 trouble tickets per month on voice problems with their Centrex system and

are now averaging approximately 15 trouble tickets per month with the VoIP system.

- Northwestern reported they have increased functionality with the new VoIP system. They sited the ability to 'park' a call and have it retrieved from anywhere in the facility as a significant time savings. They are also piloting wireless IP phones where the doctors and nurses will not have to leave the patient to communicate with other doctors, nurse stations and clinical support services.

- Northwestern reported that the VoIP system is very cost effective and that they were able to deploy the now VoIP system within budget achieving their return on investment objectives.

Clearly VoIP is a viable technology whose maturity is at a sufficient level to be placed within a medical environment where patient care and safety are paramount in the delivery patient services. With the adoption and application of any technology, risks must be assessed and actions taken to implement mitigating solutions. Even if a traditional PBX/Centrex solution were to be installed at the Replacement Facility, a myriad of other technologies, including a backup PBX would be implemented to ensure redundancy leading to sustained operation. DHS, ISD and the Office of the CIO fully understand this requirement and are prepared to make cetain all actions required are taken and implemented to ensure the integrity of the telephony solution selected. Implementing VoIP is both a strategic and tactical decision that will provide for a foundational infrastructure to be implemented allowing current and future technologies/applications to be applied in a manner that will enhance the delivery of patient services in a timely and cost effective manner.

For any questions on this report or the attachments, please have your staff contact Dennis Shelley of the Chief Information Office at 562-940-3935.

Attachment A – LAC/USC Replacement Facility Telephone System Analysis
Attachment B – Cost Estimates
Attachment C – Heathcare Users of IP Telephony
Attachment D – DHS Report on Northwestern Memorial Hospital Site Visit

LAC/USC Replacement Facility
Telephone System Analysis

Introduction

Voice over Internet Protocol (VoIP) has become the dominant technology for voice communications. The Gartner Group information technology advisory service has found that VoIP, or VoIP-enabled, business telephone system shipments from manufacturers represent the preponderance of all telephone systems being shipped and the number is increasing at a 27 percent compound annual growth rate. The use of this technology is now so pervasive that on August 24, 2006, the California Public Utilities Commission removed regulation and price caps on traditional telephone services from the major telephone companies for all business users. The Commission found that traditional wireline telephone companies now had sufficient competition in the marketplace that price regulation was no longer necessary. The Commission found that this competition had come from residential and business adoption of cable, wireless, and Voice over Internet Protocol (VoIP) technologies and services.

VoIP, usually referred to as IP telephony in business use, uses the Internet Protocol to digitize voice messages into small packets of data which are then switched like email messages via public and private data networks. Although IP telephony uses the Internet Protocol, in a business environment, IP telephone systems usually do not use the public Internet.

IP telephony has been available in the market for over 6 years, with early adoption by small businesses and residential users. Major telephone companies and data network equipment manufacturers have invested significant research into the development of this technology which has resulted in the introduction of enterprise class IP telephone systems within the commercial market to meet customer demand for function rich features available only in VoIP solutions.

Background

On January 29, 2002, the Board approved an IP telephony system for the Community Development Commission (CDC) headquarters facility. Concurrently, the Sheriff had begun implementing IP telephony systems at several of their facilities. The Office of the CIO and ISD had been watching the role out of IP telephony for several years and participated in a early evaluation of its capability. When it became apparent that departments were interested in pursuing this technology in new locations or as replacement technology for old/expired PBX solutions, it also became apparent that a more formal process needed to be in place to ensure its effective application. The CIO and ISD formed a committee of technical staff from various departments in September 2002, to formally investigate IP telephony products and services. Major manufacturers (Avaya, Cisco, Nortel, NEC, Shoreline, Alcatel) and system integrators (SBC, Verizon, Expanets, Network Catalyst) discussed their products,

services and business strategy/direction with the committee.   It was the conclusion of the committee that:

- o IP telephony would become the dominant telephone system technology and that traditional telephone systems would be phased out of the market.

- o Any of the IP telephony systems from the major manufacturers could meet the requirements of the County for telephone services

- o There was no interoperability among the new IP telephone solutions being developed. Each manufacturer had implemented their own proprietary systems and therefore no two manufacturer's systems would directly interoperate (i.e., communicate seamlessly with all features) with each other.

The CIO concluded that without industry-wide interoperability standards, the County needed to adopt a common solution. To do otherwise would result in bifurcated voice communication solution causing unnecessary complexity and support costs within the County's enterprise network.

As departments were planning for the replacement of old/expired PBX switches, they were also evaluating and questioning the value and merits of moving toward VoIP technology. This resulted in the CIO and ISD forming an interdepartmental committee in December 2003 to develop a Request for Information (RFI). ISD issued the RFI in February 2004. The RFI was used to solicit information from the industry to determine which IP telephone system(s) would provide the County with the best functionality and integration within the County's existing voice and enterprise data network. The RFI specifically requested manufacturers to demonstrate inter-operability of their products with other manufacturers so the County could adopt multiple solutions for IP telephony services. To ensure impartiality and completeness, the Gartner Group was given a copy of the draft RFI for review before it was submitted to the equipment vendors.   Responses were received from Alcatel, Avaya, Cisco, Mitel, MCI, NEC, and Nortel. An evaluation committee comprised of representatives from ISD, CIO, Sheriff, DHS, ISAB, and DPSS formally reviewed and scored the responses. References for both government and health care implementations were required and they were contacted by the evaluation committee. The results of the evaluation showed that the Cisco Systems received the highest score and was therefore determined to be the best IP telephone solution for use in the County. No equipment vendor could demonstrate inter-operability of their hardware with another manufacturer.

In June 2004, the CIO and Director of ISD notified the Board of the change in the market for telephone system technology and the actions to be taken to introduce VoIP technology. In July 2004 the CIO and Director of ISD issued a memo to department heads stating that all new or upgraded telephone systems, including

call centers, in the County would be IP based solutions. Any exceptions would require CIO review.

In September 2004, the Cisco VoIP product was added to the existing Telecommunications Equipment and Services Master Agreement (TESMA) in a new category. ISD solicited system integrators and distributors to be added to TESMA to support the new category. These TESMA qualified system integrators and distributors have the opportunity to provide the County competitive bids on IP telephony systems when, new telephone systems are required at County facilities. Cisco is not a direct TEMSA competitor and has not been identified as a system integrator. As stated in the RFI, when the industry adopts interoperability standards for IP telephony, compatible systems from other manufacturers will be added to TESMA and adopted as an acceptable alternative to the Cisco VoIP product.

In order to support IP telephony, ISD formed an internal task force of technical and operational staff to develop the processes and procedures to develop, implement, monitor, and maintain IP telephone systems. ISD's existing telephone technical staff was formally trained on IP telephone systems. ISD staff also worked closely with the TESMA contractors as they implemented the IP telephone systems in County departments to learn and adopt best industry practices.

In addition to the 250 phone CDC IP telephone system and 2,000+ IP phones implemented and supported by the Sheriff, ISD has procured and implemented IP telephone systems at the following facilities which in aggregate exceed 2000 IP phones:

> ISD - Telecommunications Facility
> Auditor/Controller - Shared Services
> DCFS - Palmdale
> DCFS - Glendora
> DPSS - 120th and Western
> Animal Control – all facilities
> DMH – 695 Vermont
> East LA County Hall

Additionally, the following locations are currently being planned or are in the implementation phase:

> Public Health Bio-Lab
> DPSS Call Center
> ISD Customer Assistance Center
> Coroner headquarters

There is no plans for the mass migration of existing County telephone systems to IP telephony. IP telephone systems will be implemented only in new facilities and when obsolete PBX's need to be replaced. The existing, newer, traditional telephone systems (PBXs, Centrex, and key systems) will remain viable for some time and will not be replaced unless economic studies, or lack of support dictate otherwise. The migration to VoIP will be measured to maximize the investment the County has made in its existing telephone systems.

Telephone System Alternatives for the LAC/USC Replacement Facility

There was no specific analysis of telephone system alternatives other than IP telephony for the LAC/USC Replacement Facility because:

- o The industry and market had already determined that IP telephony technology would be the technology for telephone systems now and for the future.
- o County staff had already installed several (Board approved) IP telephone systems in concert with the June 2004 letter to the Board articulating the new direction for implementing telephony solutions in new facilities and as replacement solution for old/expired PBX technology.
- o Implementing a VoIP telephony solution in a new facility where technology will play a critical role in the delivery of patient services was thought to be essential. Implementing a traditional solution would limit the opportunity to take advantage of new communication solutions that could lead to improved staff productivity and patient care.
- o IP telephony for the LAC/USC Medical Center was part of the Department of Health Services "Enterprise Strategy for Voice Communications" dated November 2004.
- o VoIP had been identified by DHS staff as the preferred solution for the Replacement Facility.

Although IP telephony is the recommended technology for the LAC/USC Replacement Facility there are clearly alternatives available. The following is a discussion of the traditional telephone systems that are still available in the market and the choices of how IP telephony technology can be implemented and supported:

I. Traditional Telephone Systems

A. Private Branch Exchange (PBX)
The traditional PBX is based on Time Division Multiplex (TDM) technology. With TDM technology the voice conversation is sampled, digitized, and sequenced in fixed time allocations of a high speed circuit. In the PBX, these fixed time allocations are switched among the telephone instruments and the lines coming into the PBX from the telephone company. Each telephone instrument is connected to the central

switching equipment via dedicated wires. Adds, moves, and changes of telephone instruments require moving wires in the intermediate closets and/or re-programming the central equipment. These digital PBXs have been the mainstream telephone technology for the past three decades after replacing analog, electro-mechanical switching technologies. The County currently has over 60,000 telephones on over 100 PBXs using this technology. These PBXs have been very reliable but have experienced occasional outages. Many of the County's PBX are no longer supported by the manufacturer and will need to be replaced. The LAC/USC Medical Center currently has a 250 Line PBX installed as an emergency back-up system to their primary Centrex telephone system. PBX technology is being replaced in the market with IP telephony. The Gartner Group predicts that by 2007 less than 10 percent of new enterprise telephony shipments will be traditional PBX technology. There will be no future enhancements to the features and functionality of PBXs and it will be increasingly difficult to obtain parts and skilled staff to maintain them.

B. Centrex

Centrex is a telephone company hosted service with a monthly charge per line. Centrex provides PBX functionality from the central office switching system. The switching system in the telephone company central office uses TDM technology. Individual phone lines are connected from the central office to each telephone instrument, or to a small telephone system called Key Telephone System at a County office. Centrex has fewer features than an on-site PBX and therefore the County usually has to install several Key Telephone Systems (KTS) in the facilities that use Centrex. Adds, moves, and changes of telephone instruments require moving wire and/or re-programming the KTS equipment. Centrex is a highly reliable telephone service as it is based on the public telephone network and its well established redundancies. The LAC/USC Medical Center has used Centrex services for over 30 years. It is estimated that 90 percent of the Centrex lines at the Medical Center are on Key Systems. In addition, as a back-up, there is a 250 line PBX with phones at critical locations in the hospital. Just as PBXs/ Key Telephone Systems are losing market share as businesses move to IP based telephony solutions, Centrex is also losing market share as the number of installed lines are being replaced with IP telephony services.

II. IP Telephone Systems

A. On-Site IP Telephone System

Unlike a PBX or Centrex, the IP telephone instrument does not need a direct wired connection to a central switching system. The IP telephones plug into the existing data network which switches and routes the voice packets to the required destination via the best route the network can

find.[1] Because of this, an IP telephone instrument, and its assigned telephone number, can be placed anywhere on the data network and immediately become operational. The costs of adds, moves, and changes are significantly reduced. The IP phones do not even need to be on the campus where the IP telephone system server resides. For the LAC/USC Medical Center, all the affiliated health centers and clinics can be part of the same IP telephone system via the existing enterprise wide-area data network. Calls between clinics and the Medical Center would be internal calls and they would all be on the same voice mail and phone directory system. In a business continuity/disaster restoration scenario, where operations may have to be relocated to a different location, as soon as a data network connection can be made, the phone services would be operational. Traditional telephone systems would require significantly more time and labor to restore. An IP telephony system should be considered as just another computer application on a server (i.e., email or a financial application), which is accessed ubiquitously over the data network. In addition to the IP telephone instruments, an IP telephone system also has servers that provide the call administration and phone directories as well as servers for voice mail services. There are also gateway devices which interface with public telephone network and convert the IP packets to and from the public network lines. All the servers and gateways are installed in redundant pairs to provide fail-over capability. Additionally, the gateways have the ability to continue all administration of incoming and outgoing calls if the main server(s) fail. All the IP telephony components can be monitored remotely as other data network devices are. Since IP telephony is a computer application, it can readily be integrated with other computer applications and the IP phones could be used a data input or display devices. As with the traditional telephone system alternatives for the Medical Center, a small back-up PBX system or Centrex service would be installed to provide traditional phone services at critical locations.

B. Hosted IP Telephony Services

An alternative to an on-site IP telephony system is to host the administration and voice mail servers at a central data center and provide IP telephony service through a wide area data network, such as the telephone company network. AT&T has recently introduced an IP telephony service where AT&T provides all the server hosting, voice mail services, and gateways within their nation-wide private data network. The AT&T data network would connect with the LAC/USC Replacement Facility's internal data network. IP telephones would connect to the

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[1] The Internet Protocol (IP) was developed by the Department of Defense during the Cold War to ensure the Department's distributed computer systems maintain communications in the event of a nuclear attack on the United States. The IP protocol searches through all possible network connections to find a route to the destination it is seeking and then logically establishes that path for the period of the data transmission. If the path gets broken, the IP protocol immediately seeks another path.

internal data network just as with the on-site IP telephony system. Internal calls would stay within the local data network but telephone calls outside the Medical Center would go over the AT&T network where they would be converted from IP packets and connected to the public telephone network for completion. Since the County has an existing contract with AT&T that includes Service Level Agreements (SLAs) for the performance in various services, this new IP telephone service would be covered by the current contract terms and conditions and SLAs. However, with the AT&T service, it will not be possible to integrate the IP telephony services with Medical Center computer applications as AT&T currently does not support a wireless phone service with this product. However, this may not be an issue in the future. A back-up PBX or Centrex service would be implemented as a standard practice for ensuring a viable backup capability.

Estimated Costs

The costs of the four alternatives have been estimated and are included as Attachment B. The estimates are based on the original DHS and ISD design of 6,000 business telephones, 1,000 single line telephones, 500 wireless telephones, voice mail for 6,000 users, and a back-up system of 1,000 telephones. Included is the data network infrastructure costs that include all network switches, the wireless system and cabinets, fiber and patch panels which are common to any telephone system. Also included is the other voice systems which are identified as audio and web conferencing systems, instant voice communication system used for hands free answer-back and paging services for clinical staff. Annual operational costs include telephone company charges, hardware and software maintenance costs as well as estimated staff support or contracted labor. The costs have been projected on a straight line basis over seven years, which has been the historical measure for the minimum life of any telephone system installed.

Risks, Reliability, and Support of IP Telephony

The rapid adoption of VoIP solutions is fundamentally changing the way telephone company providers are organizing and planning for the delivery of telephony. Although residential IP telephone services usually use the public Internet for transmission, the IP telephony systems used in the County and other large enterprises including the proposed solution for the LAC/USC Replacement Facility, never directly connect to the public Internet. In applying VoIP services within the County, the County will use its own internal data network or AT&T's private data network for all communication services. The reliability of IP telephony is reliant upon the viability of the data network it runs on. Unlike traditional telephone systems that have a central switching system, IP telephone uses the existing distributed data network switches in the buildings to switch the packets of voice information to the proper location. It is critical therefore that the

data network be designed, implemented, and supported to provide non-stop service. The data network for the new LAC/USC Replacement Facility will be designed to ensure its sustainability and effectiveness in accommodating broadband communications. To ensure the integrity of the County's design, an independent consultant has been engaged to review the design. Every effort will be exercised to ensure redundancy of operation leading to a high availability of telephone service.

Security of the data network and all the data that transmitted over it, including voice traffic, is of utmost importance. The design and operation of the data network by DHS must meet HIPAA standards. The voice traffic is logically isolated from the data traffic and voice traffic is given priority over other data traffic as well. All servers are protected by firewall devices and all components of the network are monitored for any suspicious hacker activities. Voice conversations on an IP telephony system are more secure from eavesdropping than traditional telephone systems. Since the voice message has been placed in digital packets and routed through the data network with all the other data traffic, it is very difficult to access, record, and re-assemble any voice conversations without very complex and costly equipment being available. Traditional telephone systems can easily be monitored at any location when distribution wiring is accessible, such as in a telephone closet or where the telephone company lines connect to the building.

Not unlike any other computer application, the IP telephony system requires routine database back-up, software updates, and real-time server monitoring. These types of tasks have not been needed with traditional telephone systems and therefore IP telephony support staff requires training in the new technology and support practices. While ISD staff has been formally trained in IP telephone systems support and maintenance and is currently maintaining several departmental systems, DHS in developing their VoIP strategy opted to install and operate their own VoIP servers at each of the hospital locations. This contrasts with the model supported by ISD where they provide centralized support services for departments implementing VoIP at the Downey data center. Given the size and complexity of the LAC/USC replacement facility along with a lack of experienced DHS personnel in the management, operation and maintenance of VoIP servers, ISD and the CIO will recommend that, for an initial period, a contractor be utilized to support the data network and IP telephony system installed at the Medical Center until staff are trained and ready to assume the daily operational responsibility.. DHS currently uses contracted staff through ISD to provide daily maintenance and support to the Centrex and key telephone systems at the LAC/USC Medical Center.

The following chart summarizes the benefits, risks, security, reliability and operational issues for the four alternatives under evaluation:

Telephony System Options for the LAC/USC Replacement Facility

	Traditional PBX	Traditional Centrex	On-Site IP Telephony	Hosted IP Telephony
Benefits	-Proven technology	-Proven technology -Inexpensive to implement	-Only system with ability to integrate phone system with other computer applications -Online directory dialing -Easier disaster recovery	-Service provided under existing SLAs and contract terms and conditions -Less expensive to implement and operate
Risks	-Obsolete technology -Ongoing support will become difficult -No new features or integration to computer applications	-Requires the use of Key Systems which use obsolete technology -No new features or integration to computer applications	-IP system is reliant upon the internal data network	-IP system is reliant upon the internal and external data network
Security	-Not Susceptible to virus or hacker attacks -Fairly easy to eavesdrop	-Not Susceptible to virus or hacker attacks -Fairly easy to eavesdrop	-Internal data network must be hardened against virus and hacker attacks -Eavesdropping very difficult	-Internal data network must be hardened against virus and hacker attacks - -Eavesdropping very difficult
Reliability	-Historically very reliable -Single point of failure	-Most reliable telephone service, Any outages usually due to cable problems	-Reliability dependant upon internal data network	-Reliability dependant upon internal data network
Operational Issues	-Expensive adds, moves and changes -No ability to monitor all system components	-Expensive adds, moves and changes -No ability to monitor all system components	-Low cost adds, moves, changes -Ability to monitor all system components	-Low cost adds, moves, changes -Ability to monitor some system components
Costs	-Low installation costs -Lowest initial operating costs	-Moderate installation costs -High operating costs	-High installation costs -Low operating costs	-Lowest installation costs -Moderate operating costs

Healthcare IP Telephony Site Visit

Representatives of DHS, ISD, and CIO visited the Northwestern Memorial Hospital in Chicago, Illinois on August 30, 2006. Northwestern Memorial Hospital is a premier teaching hospital affiliated with Northwestern University. This hospital resembles the size and complexity of the LAC/USC medical center. County representatives discussed the hospital's experience with IP telephony with the hospital's information technology staff and management as well as clinical staff. Northwestern Memorial Hospital is replacing their 8,000 line Centrex telephone service with IP telephony. They decided to replace the Centrex system due to ongoing service problems, costly support operations, and lack of productivity enhancing features. They have implemented over 4,000 IP telephones to date and are migrating 100 phones per week to the new system. They reported that the IP telephone system has been reliable and they have not experienced any system outages. Recently they have begun deployment of wireless IP telephones. The wireless IP phones provide the physicians with immediate access to, and from, other staff wherever they are in the facility. The hospital had a 300 line PBX system as a back-up to their Centrex system and they have kept that in place as a back-up to the IP telephone system. See Attachment D for the detailed DHS report on the Northwestern Memorial Hospital site visit.

Other Users of IP Telephony

IP telephony is now a mainstream telephone system for critical business use. Major corporations such as Boeing, Ernst & Young, Ford, Hewlett-Packard, IBM, AT&T, Oracle, and Lehman Brothers have each installed over 25,000 IP telephones. IP telephony is also growing in its penetration within health care facilities. County CIO staff contacted six of the larger healthcare providers that were identified as having implemented IP telephony systems to ascertain the depth of the deployment and satisfaction with the technology. This information is provided in Attachment C.

Conclusion

IP telephony, as with other new technologies, brings an element of risk due to the lack of staff experience, new support processes and procedures, and reliance upon the legacy infrastructure. However, the benefits of a virtual telephone system, no longer tied by direct wired connections; integration to existing and future computer applications; and investment protection versus traditional telephone systems, outweigh the possible risks. Risks need to be understood and managed. Any solution identified and put in place must include a robust and secure data network infrastructure supported by redundant IP telephony components as well as a sound management support structure. All the involved departments recognize the issues of implementing IP telephony, especially the

ongoing support requirements and have been working cooperatively for the past several months in identifying and defining options. DHS, ISD, and the CIO are still evaluating the implementation and support strategies for the telephone system for the LAC/USC replacement facility. Within the next two months a final recommendation will be developed and provided to DHS management and the Board before any telephone acquisition is initiated. Within this timeframe, any solution selected can be procured and implemented in accordance with the construction and move-in schedule.

The decision regarding the viability of VoIP is not the issue and any solution considered will surely take advantage of this technology. To do otherwise, would be a mistake hindering the ability of the County's health organizations to take advantage of new technology and clinical services that will be dependent on IP telephony for improving communications and delivering improved clinical services in the future.

Attachment B
LAC+USC Replacement Facility
Telephone System Analysis

Estimated Costs for Alternative Telephone Systems
One-Time and Annual Operational Costs

System Component	Traditional				IP Telephony			
	PBX		Centrex		On-Site		Hosted	
	One Time	Annual	One Time	Annual	One Time	Annual	One Time	Annual
Data Network								
(required regardless of type of telephone system installed)	$12,029,480	$1,190,979	$12,029,480	$1,190,979	$12,029,480	$1,190,979	$12,029,480	$1,190,979
Voice Systems								
Telephone System								
PBX	$4,137,010	$339,840						
Centrex and Key Systems			$4,394,530	$100,000				
IP Telephone Systems					$8,382,228	$704,295	$3,854,290	$50,000
Other voice systems (Conferencing and Instant Voice System)	$1,367,800	$159,977	$1,367,800	$159,977	$1,367,800	$159,977	$1,367,800	$159,977
Telephone Company Line Charges	$66,784	$147,264	$490,000	$1,050,000	$66,784	$147,264	$0	$1,605,888
Adds, Moves, and Changes		$200,000		$400,000		$100,000		$100,000
Telephone Company Call Charges		$229,101		$229,101		$229,101		$10,717
Voice Mail (Service Cost)				$450,000				
Back-Up System								
Centrex			$279,050	$203,904	$279,050	$203,904		
PBX	$220,000	$144,000					$220,000	$144,000
Voice Systems Total	$5,791,594	$1,220,182	$6,531,380	$2,592,982	$10,095,862	$1,544,541	$5,442,090	$2,070,581
Data Network and Voice Systems Total	$17,821,074	$2,411,161	$18,560,860	$3,783,961	$22,125,342	$2,735,520	$17,471,570	$3,261,560

7 Year Cumulative Costs

System Component	Traditional		IP Telephony	
	PBX	Centrex	On-Site	Hosted
Data Network	$20,366,333	$20,366,333	$20,366,333	$20,366,333
Voice Systems	$14,332,865	$24,682,251	$20,907,647	$19,936,159
Total	$34,699,199	$45,048,585	$41,273,980	$40,302,492

Notes:
1. The data network infrastructure includes all the data switches, the wireless system, and the cabinets, fiber, and patch panels, which are common to any telephone system installed.
2. The other voice systems are an audio and web conferencing system and an instant voice communication system used for hands free, answer-back, paging for clinical staff.
3. Annual operational costs include telephone company charges, hardware and software maintenance costs from the manufacturers, and estimated staff support and/or contracted labor.
4. The costs have been projected on a straight line basis out seven years, which would be the minimum life of any telephone system installed.

Attachment C

LAC/USC Replacement Facility
Telephone System Analysis

Heathcare Users of IP Telephony

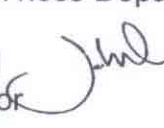| Facility	Location	Total # of Phones	# of IP Phones	Primary system?	Back-up system
Clarian Health Partners (5 hospitals)	Indianapolis, IN	16,000	3,000	IP is primary system at one hospital and several clinics, other hospitals and facilities being converted over next 3 years from PBXs to IP	Small PBX in each hospital providing back-up at critical locations.
VA Medical Center	Dayton, OH	3,000	2,000	IP system is primary. 1,000 analog phones for patients, fax, and non-critical functions	Individual business lines to critical locations and cell phones
Community Health Network -Indiana Heart Hospital	Indianapolis, IN	11,000	2,500	Primary system for hospital, other facilities converting from PBXs	Small PBX – ratio of 20 IP phones to 1 back-up phone
Children's Hospital of Boston	Boston, MA	10,000	2,000	Existing PBX is primary. 250 IP phones in new hospital and other IP phones in administrative facilities. Other facilities being converted from large PBX.	Individual business lines to critical locations
Yavapai Regional Medical Center	Prescott, AZ	1,500	1,500	IP system is primary	No back-up system, only redundant IP system servers
Northwestern Memorial Hospital	Chicago, Il	8,000	4,000	IP system considered primary. 100 phones per week are being converted from Centrex to IP.	Small PBX of 300 phones at critical locations

September 7, 2006

TO: Bruce A. Chernof, M.D.
        Director and Chief Medical Officer

        Jon W. Fullinwider
        Chief Information Officer

        Dave Lambertson
        Director, Internal Services Department

FROM: John R. Cochran, III
        Chief Deputy Director

SUBJECT: **REPORT OF VOiP SITE VISIT TO NORTHWESTERN
          UNIVERSITY MEDICAL CENTER**

Attached is the final report that discusses the findings of the site visit team from the Department of Health Services (DHS), Internal Services Department (ISD), and the Chief Information Office (CIO) to Northwestern University Medical Center (Northwestern). Although this document was reviewed by the respective participants and their comments incorporated, DHS takes total responsibility for its content.

Our site visit was extremely productive. It demonstrated the value of VOiP technology in a sophisticated and complex healthcare environment. The DHS staff came back from this visit excited for the potential the technology offers our facilities to provide contemporary communications technology which can add new features as the healthcare environment adapts this technology to the hospital setting.

As you are aware, hospitals have not been on the leading edge of technology adoption in areas where potential concerns about 24x7x365 availability are involved. Of the more than 5,700 licensed hospitals in the U.S., a small number were identified in your research and the research conducted by CISCO that had actually installed a VOiP solution. In Patrick Anderson's conversation with Gartner's VOiP expert, he noted that hospitals across the country have been very slow to adopt this technology and for the most part are in the planning stage. Northwestern, widely recognized for leading the hospital industry in technology adoption, only deployed VOiP in their clinical nursing areas in the past 12 months, despite having been evaluating and working on it for more than 7 years. We received the benefit of their many years of experimentation, testing, evaluation and implementation as a result of our site visit.

Patrick Anderson and I fully support the deployment of VOiP voice technology at LAC+USC, incorporating the critical success factors learned from our site visit and research. The site visit report also reflects the recommendations made by the Northwestern and CISCO VOiP hospital technology staff on the steps necessary for LAC+USC to have a successful install and operation of VOiP. We plan on developing a plan which reflects these components with ISD and the CIO and to proceed with completing the telecommunications plan for the LAC+USC complex.

If you have any questions, please call me.

JRC:jrc

Attachment

c: Patrick Anderson
      Pete Delgado

Technology Evaluation
Department of Health Services
Voice Over IP – LAC-USC Medical Center

Executive Summary and Recommendation

The Department of Health Services recognizes the functionality of VOIP and recommends the technology be deployed across the DHS enterprise subject to the critical success factors for the successful deployment of the technology. The ISD VOIP engineering team and the LAC+USC I.T. leadership must work together to incorporate the 13 critical success factors into the planning, architecture, and ongoing operational component of the VOIP project. If that is done, our visit confirms that VOIP can be effectively used in a complex, multi-building hospital environment.

Objective of Evaluation:

Deploy a cross functional team from the County of Los Angeles to identify an academic hospital comparable to the LAC+USC Medical Center in terms of number of beds and volume of patients that has successfully deployed VOIP. Perform on site validation and first hand review of the technology. A thorough review included the following:

- Evaluation of reliability
- Evaluation of functionality
- Evaluation of cost effectiveness
- Evaluation of lessons learned including the documentation of the critical success factors for implementation and ongoing operations.

Evaluation Team:

- John Cochran – Chief Deputy Director, DHS
- Patrick Anderson – Chief Information Officer, DHS
- James Yu – I.T. Manager, LAC+USC Medical Center
- Rosie Jones - Telecommunications Manager, DHS
- Dennis Shelley – Associate CIO, County of LA
- Robert King – Manager, Premise Systems Division, ISD
- Henry Kao – VOIP Project Manager, ISD

Date, Location and Point of Contact for Evaluation:

- August 30, 2006
- Northwestern Memorial Hospital, Chicago, Illinois
- Dwayne Moehl, Project Director, Information Services

Technology Evaluation
Department of Health Services
Voice Over IP – LAC-USC Medical Center

EVALUATION

Comparable Hospital Selection

The DHS team members reviewed several potential hospital environments for this evaluation. These hospitals included,

- VA Portland, Oregon,
- Yavapai Regional Medical Center, Prescott, Arizona
- Northwestern Memorial Hospital, Chicago, Illinois
- First Health of the Carolinas, Pinehurst, North Carolina
- Exempla Healthcare, Denver, Colorado.

Northwestern Memorial Hospital was selected because this hospital is the primary teaching hospital for Northwestern University's Feinberg School of Medicine with 544 primary care beds and 167 beds in the Women's Hospital. The medical school also has other care facilities with additional beds. It is the largest birthing center in the state with nearly 10,000 births annually. The emergency department is a Level 1 Trauma Center which treated over 70,000 patients last year. The Medical Center has approximately 6,500 employees including a medical staff of 518 residents and 125 fellows.

The other hospital environments were not comparable to LAC+USC resulting in the selection of Northwestern Memorial Hospital.

Review of the Technology Decision by Northwestern Memorial

Northwestern is very similar to LAC USC Medical Center in that they used Centrex from the phone company (AT&T). Northwestern spent 7 years evaluating the new VOIP technology to replace Centrex. The replacement goals were:

a) Replace Centrex: cost of Centrex was escalating for both voice and voicemail.
b) Studied Centrex reliability: although never had system wide outages, had constant loss of individual service to individual phones.
c) Goal was to have information for staff anytime and anywhere, not just at fixed sites.
d) Wanted to eliminate 1-2 week delays in getting Centrex moves-adds-changes performed by AT&T the local telephone carrier.
e) Wanted an integrated single vendor solution vs. best-of-breed multi vendor solution for reliability and single response – no "finger pointing" about whose parts didn't work.

Northwestern also felt that the Centrex offering did not provide for new functionality and VOIP is adding new functionality at a consistent rate. Northwestern issued RFP in 2002 for VOIP system. They performed research and vendor comparisons and chose Cisco because of their market share and unique capability to leverage the data network with more advanced functionality and reliability than other vendors which included Avaya as the runner up. Northwestern also wanted a technology that was scalable and they believe that Cisco will meet that significant requirement as Northwestern is experiencing significant growth.

Review of the Operational Component

The review of the operational component consisted of working with the Hospital VOIP engineering team and with the executive I.T. management team. We discussed the reliability, functionality, cost effectiveness, and lessons learned. The lessons learned section had significant insight for the County team in terms of learning first hand about critical success factors. These factors should be the primary action items as a result of this evaluation.

Evaluation of the reliability of the VOIP system

Prior to the VOIP implementation at Northwestern, the engineering group was incurring approximately 300 tickets per month for voice outages within the enterprise. After the VOIP implementation the team is incurring approximately 15 voice outages per month. The reliability according to the engineering team has increased significantly.

The engineering team did state that there were some issues at start up that would have been avoided if a test environment was available prior to deployment as integration with voice mail for campus partners did fail. Rigorous change management also contributes to high availability as all changes to the environment are reviewed, tested, and recovery plans are documented. All technicians are also aware of all changes to assist with fault isolation and resolution. The nurses on a medical ward and the nursing supervisor and ward secretary also reported no reliability issues. At each clinical area, a red phone is installed using a local PBX for emergency internal communications. Since they cut over to VOIP in July 2006, they have not had to use the emergency phone.

The engineering team stated that their high degree of reliability is due to the redundant hardware eliminating all single points of failure at the server, storage, switch and power supply level. Northwestern built 3 complete VOIP server locations so that if any one location failed, they had 100% redundancy in the other two locations providing failover. Further, the team noted that multiple phone company central office points of entry are also required to ensure critical success. Implementing a program of 24 x 7 monitoring of the systems to identify early

indicators of problems and intervention with urgency is critical to maintain high availability of the systems. Migrating from a multi-vendor data solution to a single vendor solution for a voice and data network system also contributed significantly to the reliability. Northwestern was working with 3Com, Cisco, Cabletron, and Checkpoint to manage the infrastructure prior to the single vendor solution from Cisco. This single vendor solution allows for better integration and more complete monitoring resulting in overall reliability. The up-front planning around the human workflow is also very important. The workflow study needs to occur for each department prior to deployment to ensure critical processes are not broken which could result in a work slowdown or work stoppage. One solution is to have a branding campaign and initial training of supervisors and management and ask them to consider workflow implications and then have the deployment team further analyze the input from the supervisors and management. The workflow and dial plan/profile setup is a critical success factor. Comprehensive user training is also a factor. Both Cisco and Northwestern recommended that a Cisco top tier integrator with their proven processes be utilized for infrastructure implementation and setup.

Evaluation of the functionality of the VOIP system

Northwestern is very happy with the current and future functionality of the Cisco VOIP telephony solution. Today the largest benefit is from the nurse station ability to "park" a call and page the nurse with "call park" number who can pick up the call from anywhere within the hospital. This has a significant time savings impact on the ward nurses and the ward secretary. The secretary stated that her call handling time has been cut in half as she does not have to follow up with nurses to ensure they get the calls. Northwestern is also expanding the use of the integration with the wireless access points. Doctors are piloting using the Cisco wireless phone which allows them integration with the telephone at all times. The features include; push to talk and clinician paging. The physicians and nurses will not have to leave the patient to communicate with peers and nurse stations. This wireless integration will also allow for patient charting at virtually all locations with the addition of the Mobile Access solutions that integrate with the wireless access points. This solution improves wireless access by 35%.

Evaluation of the cost effectiveness of the VOIP system

Northwestern was able to immediately see a return on investment simply by migrating the voice mail boxes of 6,000 users from Centrex to the VOIP Voice Mail system. This saved about $40,000 per month. The cost of vendor support for moves, adds and changes significantly eliminated with the implementation of VOIP. Overall, they achieved cost reduction on the support of Centrex telephone system of $1.0 million per year. Northwestern was able to deploy VOIP on budget and they have met their ROI targets.

Technology Evaluation
Department of Health Services
Voice Over IP – LAC-USC Medical Center

<u>Evaluation of the lessons learned of the VOIP system</u>
The Northwestern team shared their experience in the areas of critical success factors which they strongly urged the County engineering team to consider:

- Rigorous change management including a separate test environment.
- Redundant hardware– single points of failure eliminated
- Top tier integrator professional services for implementation
- Multiple phone company central office points of entry
- 24 x 7 monitoring and staffing in a network operations center
- Voicemail integration analysis with campus partners (medical school)
- Single vendor solution
- Workflow analysis and design prior to implementation at the unit level
- Supervisor training
- User training
- Deploy VOIP in phases, first to IT, administration next and finally clinical areas
- Establish a Network operations Center to monitor, maintain and repair VOIP system at a level equal or better than current vendor
- No new technology gets deployed to a clinical area or new building before full test and acceptance in existing buildings